Appendix A-2

Air Quality Methodology and Assumptions

A-2. Air Quality Methodology and Assumptions

This appendix presents detailed emission calculation results and tables for the construction of the control structure and lining of the spillway chute and stilling basin, including all associated activities. The analysis consists of a quantitative evaluation of construction work that would be performed during the 2010 through 2016 time period. Dispersion modeling was not conducted because the graded area would not exceed 15 acres.

A.1 Methodology and Calculations

The construction emissions were estimated from several emission models and spreadsheet calculations, depending on the source type and data availability. Emission factors from the Folsom Dam Safety and Flood Damage Reduction Final EIS/EIR (Reclamation 2007) or Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009) were used whenever possible. Project emissions were estimated from appropriate emission factors, features being worked, and associated schedules. The following construction sources and activities were analyzed for emissions:

- On-site construction equipment and construction truck engine emissions (all pollutants).
- On-site and off-site haul truck engine emissions (all criteria pollutants and carbon dioxide).
- Off-site worker vehicle trips to and from the site.
- On-site and off-site haul truck fugitive dust emissions for paved and unpaved road travel.
- On-site material storage piles.
- On-site concrete batch plants.
- On-site demolition and grading (cut/fill for control structure) fugitive dust.
- On-site blasting emissions.

Spreadsheets showing each of the calculations are included in this appendix.

A.1.1 EXHAUST EMISSIONS

Diesel- and gasoline-powered vehicles and construction equipment would emit the criteria pollutants carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter (PM) during all construction activities. This section describes the exhaust emission calculations.

A.1.1.1 On-site Construction equipment and truck engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Final EIS/EIR (Reclamation 2007). That study calculated on-site construction equipment and truck engine emissions based on the El Dorado Air Pollution Control District's (APCD) Guide to Air Quality (El Dorado, 2002).

The construction equipment emission rates are shown in Table A2-1. For this analysis, it was assumed that the emission factors for 2011 through 2016 were equal to those in 2010 and that the emission factors were based on an 8-hour work day.

The horsepower (hp) of the drilling rigs for this construction project was assumed to be 140 hp, which was less than the assumed horsepower used for the emission estimations in the Folsom Dam Safety and Flood Damage Reduction Final EIS/EIR. Therefore, emission factors from the Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009) were used for the bore/drill rigs in this EA. To be conservative, the emission factors for a 175 hp drill rig were used for calculations.

Table A2-1 . Construction Equipment Emission Factor (pounds per day) for 2009 - 2016.

	Emission Rate in Pounds Per Day			
Equipment Type	**ROG/VOC**	**CO**	**NO_x**	**PM_{10}**
Bore/Drill Rigs (Reclamation, 2007)				
2009	2.38	20.21	16.41	0.38
2010-2016	2.26	19.23	15.61	0.36
Bore/Drill Rigs (Corps, 2009)				
175 hp	0.966	6.033	9.19	0.469
	(54.76 g/hr)	(342.09 g/hr)	(521.05 g/hr)	26.59 g/hr)
Paving Equipment				
2009	1.04	8.23	6.78	0.22
2010-2016	1.04	8.52	6.39	0.19
Rollers				
2009	0.86	7.34	5.01	0.14
2010-2016	0.86	7.34	5.01	0.14
Cranes				
2009	1.44	12.27	8.37	0.23
2010-2016	1.44	12.27	8.37	0.23
Crawler Tractors				
2009	1.45	11.55	9.5	0.31
2010-2016	1.45	11.95	8.96	0.27
Crushing/Proc Equipment				
2009	2.12	16.86	13.88	0.45
2010-2016	2.12	17.45	13.09	0.4
Rough Terrain Forklifts				

2009	0.79	6.7	4.57	0.13
2010-2016	0.79	6.7	4.57	0.13
Rubber Tired Dozers				
2009	3.66	29.13	23.97	0.78
2010-2016	3.66	30.14	22.61	0.68
Rubber Tired Loaders				
2009	1.35	11.52	7.86	0.22
2010-2016	1.35	11.52	7.86	0.22
Excavators				
2009	1.84	15.64	10.67	0.29
2010-2016	1.84	15.64	10.67	0.29
Graders				
2009	1.76	14.98	10.22	0.28
2010-2016	1.76	14.98	10.22	0.28
Off-Highway Tractors/Compactors				
2009	1.84	14.65	12.05	0.39
2010-2016	1.84	15.16	11.37	0.34
Scrapers				
2009	3.64	30.96	21.12	0.58
2010-2016	3.64	30.96	21.12	0.58
Skid Steer Loaders				
2009	0.56	4.78	3.26	0.09
2010-2016	0.56	4.78	3.26	0.09
Off-Highway Trucks/Water Trucks				
2009	3.6	30.62	20.89	0.58
2010-2016	3.6	30.62	20.89	0.58
Other Construction Equipment				
2009	2.08	16.54	13.61	0.44
2010-2016	2.08	17.11	12.84	0.39
Pavers				
2009	1.37	11.62	7.93	0.22
2010-2016	1.37	11.62	7.93	0.22
Surfacing Equipment				
2009	3.77	29.99	24.68	0.8
2010-2016	3.77	31.03	23.28	0.7
Tractors/Loaders/Backhoes				
2009	0.65	5.18	4.26	0.14
2010-2016	0.65	5.36	4.02	0.12
Trenchers				
2009	1.00	8.53	5.82	0.16
2010-2016	1.00	8.53	5.82	0.16

ROG Reactive Organic Gas

VOC Volatile Organic Compound

A.1.1.2 On-site and off-site haul truck engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors in grams per mile for criteria pollutants and for carbon dioxide for 2009 heavy-heavy duty diesel trucks in Sacramento County. The emission factors were based on the EMFAC mode with a speed of 15 mph. Mitigation reductions for NO_x and PM based on the Sacramento Metropolitan Air Quality Management District (SMAQMD) guidance was used for on-site haul trucks.

A.1.1.3 Off-site worker vehicle trips engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors in pounds per 1000 miles for criteria pollutants and for carbon dioxide for the commutes of workers. The calculations assumed a vehicle fleet mix of fifty percent light duty automobiles and fifty percent light duty trucks. The emission factors are shown in Table A2-2.

Table A2-2. Construction Equipment Emission Factor (pounds per 1000 mile).

Vehicle Description	Emission Rate in Pounds Per 1000 Miles						
	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Light Duty Automobile (LDA)	8.87	832	0.756	0.0694	0.0393	0.00786	0.991
Light Duty Truck (LDT)	10.6	1020	1.22	0.0905	0.0566	0.0131	1.12
Average based on 50 percent LDA and 50 percent LDT	9.75	927	0.99	0.0800	0.0479	0.00959	1.06

A.1.2 FUGITIVE DUST EMISSIONS

Fugitive dust and PM emissions are produced during vehicle travel on paved and unpaved roads, during handling of stockpile material, cut and fill operations, blasting, and concrete batch plant operation.

A.1.2.1 Off-site haul truck and worker vehicle fugitive dust emissions for paved road travel.

This EA used emission factors calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Paved road entrained fugitive dust emissions were estimated using the AP-42 13.2.1 emission factor (pounds per vehicle mile traveled) and the vehicle miles traveled. The emission factor was calculated based on the silt content of the road, the weight of the vehicle, and the number of days where precipitation was over 0.01 inches. The vehicles were assumed to travel on five different types of paved roads: freeway, arterial (major street/highway), collector road, local road surface and rural road surface. The off-site truck haul trucks were assumed to be heavy-heavy duty diesel trucks with an average weight of 23.5 tons. The worker fleet was assumed to be 50 percent light duty automobiles and 50 percent light duty trucks with an average weight of 1.75 tons.

A.1.2.2 On-site haul truck fugitive dust emissions for unpaved road travel.

This EA used emission factors calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Unpaved road entrained fugitive dust emissions were estimated using the AP-42 13.2.2 emission factor (pounds per vehicle mile traveled) and the vehicle miles traveled. The emission factor was calculated based on the silt content of the road, the weight of the vehicle, and the number of days where precipitation was over 0.01 inches. Fugitive dust from unpaved roads during hauling of excavated material from the control structure area to the MIAD would be the primary emission source. These emissions would be produced during the nine months of excavation.

A.1.2.3 On-site material storage pile handling.

This EA used assumptions and emission factors that were calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Stockpile handling fugitive dust emissions were estimated using the AP-42 13.2.4 emission factor (pounds per ton) and the amount of material handled. The emission factor was based on the mean wind speed and material moisture content. Mitigation reductions from watering controls would contribute to a 90 percent emission control efficiency compared to the unmitigated emissions.

A.1.2.4 On-site material storage pile wind erosion.

This EA used assumptions and emission factors that were calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Stockpile wind erosion fugitive dust emissions were estimated using the AP-42 13.2.5 emission factor (grams per square meter of exposed area) and the area exposed to wind. The emission factor was based on the fastest mile wind speed and the number of disturbances of the storage pile. It was assumed that material would be added to the pile each day and therefore the number of disturbances to the storage pile would be equal to the number of working days per year. For the storage pile of excavated material, this would be equal to the number of workdays during the nine months of excavation, or 180 working days. For the storage pile of aggregate material (for the concrete batch plants) this would be equal to the number of workdays per year, or 240 working days.

A.1.2.5 On-site concrete batch plants.

This EA used methodology and assumptions from AP-42 11.12. The emission factors for concrete batching calculate pounds of PM_{10} per ton of mixed concrete. The emission factors are shown in Table A2-3.

Table A2-3. Concrete Batching Emission Factor (pounds of PM_{10} per ton of concrete).

Batch Plant Source	Uncontrolled	Controlled

Aggregate transfer	0.0033	ND
Sand transfer	0.00099	ND
Cement unloading to elevated storage silo (pneumatic)	0.46	0.00034
Cement supplement unloading to elevated storage silo (pneumatic)	1.10	0.0049
Weigh hopper loading	0.0024	ND
Mixer loading (central mix)	0.134	0.0048
Truck loading (truck mix)	0.278	0.016
Total	1.98	0.033

ND = No data

Mitigation reductions from watering controls would contribute to a 90 percent emission control efficiency compared to the unmitigated emissions.

A.1.2.6 On-site demolition and grading (cut and fill).

Similar to calculations in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009), this EA used the URBEMIS2007 model to calculate cut and fill fugitive dust emissions. The URBEMIS2007 model calculated fugitive dust emission based on the maximum daily volume disturbed. The daily volume disturbed was assumed to be 1,778 cubic yards per day based on the total volume to be excavated and the construction period.

A.1.2.7 On-site blasting emissions.

This EA used assumptions and emission factors that were calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Blasting emissions were estimated using the methodology in the 2005 Blue Rock Quarry Draft Environmental Impact Report and were based on a blasting emission factor and the number of blasts per year. The calculation of the blasting emission factor depended on the blast area, blast depth, and moisture content. The mitigation control efficiency for PM_{10} was assumed to be 36 percent (Corps 2009).

A.1.3 GREEN HOUSE GAS (GHG) EMISSIONS

The principal greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFC), hydrofluorocarbons (HFC), and water vapor. Carbon dioxide is produced during the burning of fossil fuels and is the predominant greenhouse gas created during this project. Because no major sources exist for the other greenhouse gases during the construction process, they are not considered to be significant and no quantitative emission calculations were made for them.

A.1.3.1 On-site Construction equipment and truck engine emissions.

This EA used CO_2 emission factors (grams per hour) from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from SMAQMD published off-road emission factors for 2009, which defined emission factors for different types and sizes of construction equipment. The Corps calculated CO_2

emissions by multiplying the emission factor by the number of hours each equipment type was estimated to operate.

A.1.3.2 On-site and off-site haul truck engine emissions.

This EA used CO_2 emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors for carbon dioxide for 2009 heavy-heavy duty diesel trucks in Sacramento County. The emission factors were based on the EMFAC mode with a speed of 15 mph.

A.1.3.3 Off-site worker vehicle trips engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors for carbon dioxide for the commutes of workers. The calculations assumed a vehicle fleet mix of fifty percent light duty automobiles and fifty percent light duty trucks. The emission factor for CO_2 is shown in Table A2-2 along with the emission factors for criteria pollutants.

A.1.3.4 Concrete batch plants.

The manufacture of concrete requires large amounts of energy to produce and results in substantial GHG emissions. Calculating these emissions would be more indicative of a “life-cycle” emissions analysis and can go beyond a typical EA analysis. However, the Corps estimated CO_2 emissions from the production of concrete during this project based on published emission factors. Studies have shown that CO_2 emissions generated by typical normal strength concrete mixes were found to range between 0.29 and 0.32 metric tons of CO_2 equivalent per cubic meter of concrete (Flowers and Sanjayan, 2007). In order to be conservative, this study assumed 0.32 metric tons (320 kilograms) of CO_2 would be created per cubic meter of concrete produced.

References:

El Dorado County Air Pollution Control District, February 2002. Guide to Air Quality Assessment.

Flowers and Sanjayan, 2007 (Abstract): “Green House Gas Emissions Due to Concrete Manufacture, The International Journal of Life Cycle Assessment. Vol 12, Number 5, July 2007. Landsberg, Germany: Ecomed.